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AN INDEX OF THE PHYSICAL VOLUME OF PRODUCTION

EDMUND E. DAY

I. AGRICULTURE, 1879–1920

The Need of an Index of Physical Volume

ECONOMIC events of recent years have emphasized the need of an index of the physical volume of production. In the first place, the rapid rise of prices since 1897 has made it impossible to reason directly from wealth in terms of money to wealth in terms of concrete goods. The money measure itself has been undergoing change. The course of physical production has been obscured behind a screen of rapidly changing money values. This difficulty, troublesome ever since the price revolution began in the late 90's, has been especially serious since prices soared under the influences of war finance. Inflation has broken the customary connectives between the pecuniary and the physical volumes of production, and made first-hand knowledge of physical production more than ever desirable.

In the second place, uncertainty as to the future of prices has lent special interest to information regarding actual output and supply in terms of physical units. Explanations of current high prices have both given and denied general underproduction and shortage as the underlying cause. That greater production is of fundamental importance in the general reduction of prices is universally admitted; but whether current production is large or small, increasing or decreasing, satisfactory or unsatisfactory, is a matter of controversy. In the interest of scientific diagnosis, the need of accurate data on current physical production is unmistakable.

In the third place, the war has driven home the fact, long since axiomatic in economic discussion, that the general weal rests at bottom, not upon the aggregate of outstanding pecuniary values, but upon the sum total of goods and services available for consumption. Through the inevitable process of inflation, the war has greatly increased the money value of existing wealth. Book values have risen enormously. It is just as obvious, however, that the stupendous waste and destruction of military and naval operations have greatly diminished the physical stock of accumulated capital. Society has been actually impoverished. The extent of the loss, and the effort and time required to replace it, cannot be adequately calculated in terms of dollars and cents. Information is needed regarding the physical volume of accumulated wealth and the annual flow of goods and services.

Existing Studies of Physical Volume

Despite the scientific value which a reliable index of physical volume is certain to possess, there has been thus far almost no endeavor to construct such an index. One index of physical volume, however, to which reference is frequently made, was compiled in 1919, under the able direction of Professor Wesley C. Mitchell, by the Price Section of the Division of Planning and Statistics of the War Industries Board. The investigation was of the volume of production of raw materials during the years 1913–18. Separate indices were constructed for the production of vegetable farm products, animal farm products, forest products, mine products, fisheries products, and the total list of 90 raw materials.[1] No list of the specific commodities used in constructing the indices or of actual quantities was published, however. Mitchell's study of physical volume was made in the course of a comprehensive investigation of prices, and appears to have been only an incident in the larger investigation. It was published with so little comment upon the materials used and the methods adopted that it cannot be viewed as a serious attempt to supply the need of a general index of physical volume, even for the brief period for which it was constructed.

Physical production has twice been given passing analysis in the columns of The Review of Economic Statistics. In the July, 1920 issue, indices of physical production are developed for the years 1913–19 for 14 farm and forest products, for 16 mineral and manufactured products, and for the full list of 30 commodities. Indices are also derived for 1919–20 for 7 leading industries: pig iron, lumber, bituminous coal, crude oil, cotton, wool, and wood pulp. In the July, 1920 Supplement on "Business and Financial Conditions Following the Civil War in the United States," indices of physical production are given for agriculture (1862–80), manufacture (1864–80), mining (1860–80), and for the entire 21 articles (1864–80). However, no attempt is made to relate these two studies to each other, and in neither is there any endeavor to consider intensively the problems of method involved in the construction of an index of physical volume.

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[1] See *Federal Reserve Bulletin*, April, 1919, p. 336. The indices, with the number of commodities upon which each is based, are given in the following table:

Year	All commodities (90)	Farm Products		Forest products (23)	Mine products (27)	Fisheries products (2)
		Vegetable (25)	Animal (13)			
1913	100	100	100	100	100	100
1914	99	106	100	97	85	86
1915	107	112	107	96	99	100
1916	111	100	114	114	130	100
1917	114	107	113	111	132	130
1918	116	106	126	99	127	118

The indices were obtained by multiplying the quantities produced during each of the six years by the 1913 prices. The indices thus reflect changes in the quantities produced, and not at all any changes in prices.

The Scope of the Present Study

It is proposed in the present study to examine the course of physical production in the United States from 1879 to date, and, so far as the data will permit, to develop indices registering changes in the physical volume of output in the major divisions of industrial activity.

The period from 1879 to date is selected for a number of reasons. In the first place, 1879 is as early a year as can be covered without encountering very serious deficiencies of data. Secondly, the inclusion of the years from 1879 to the middle 90's brings within the study a period of falling prices to be contrasted with the period of rising prices since 1896. Finally, January 1, 1879, the date of the resumption of specie payments after the Greenback episode, marks the beginning of a new era in the economic life of the country. By 1879 the last burdensome legacies of the Civil War had been thrown off, and the country entered upon a period of thirty-five years of peaceable industrial expansion. Thus from different points of view, the years from 1879 to date are indicated as a satisfactory period for the investigation of the course of physical production in the United States.

Recognition of the major divisions of industrial activity is desirable in the construction of indices of physical volume because of the fundamentally different conditions surrounding production in such lines as agriculture, mining, and manufacture.[1]

In agriculture, the round of the seasons and the vagaries of climatic change — of rainfall, temperature, wind — play a commanding part in determining the outcome of the farmer's productive efforts. There is an element of the fortuitous in agriculture which is hardly equaled in other lines of activity. Furthermore, agriculture is peculiar in that the unchanging and unchangeable period of production is the year. In mining and manufacture, interest may attach to monthly data of output. In agriculture, while we may have monthly *estimates* of output, the output in question is always of the crop year.

Mining in turn is peculiar in that production normally involves an exhaustion of the deposit from which the current output is drawn. Agriculture may involve an exhaustion of the soil, but does not ordinarily if scientifically conducted.

Manufacture differs from both mining and agriculture in being much less immediately bound by natural limiting forces, and in being indefinitely expansible in most lines except as agriculture and mining themselves afford only limited amounts of material for fabrication and equipment. Manufacture, furthermore, as contrasted with agriculture, shares with mining, a sensitiveness to general business conditions. Marked variations of output may occur within a single year; in fact, within much shorter periods. Seasonal variation and cyclical movements may be expected to appear in the physical output of mine and mill. Data for monthly and quarterly periods consequently are significant and should be analyzed whenever available.

The reasons for examining separately the physical volume of production in agriculture, mining, and manufacture are manifest. The advantages of such separation will become clearer as the study proceeds. In this first part, attention will be devoted to production in agriculture from 1879 to 1920. Later installments will endeavor, so far as the available data will permit, to develop indices for mining and manufacture, and perhaps for industry as a whole.

Methods Employed

The construction of an index of the physical volume of production encounters both the difficulties common to the construction of all index numbers and the special difficulties arising from the absence of a common unit. The formation of a satisfactory index number of any kind is never an easy task. Lack of uniformity and continuity in the data, conflicting advantages and disadvantages in the various forms of aggregates and averages, uncertainty regarding the proper weights, these and many other difficulties complicate the work. But in index numbers of prices, all commodities, whatever their individual peculiarities, are expressed in a single common denominator — the monetary unit. In index numbers of physical volume, upon the other hand, it is necessary to work with data in tons, long and short, in quarts, liquid and dry, in pounds, in bushels, in gallons. This fact is fundamental in studies of physical volume, and has an important bearing upon the methods to be adopted in constructing an index of the physical volume of production.

In the present study, it is proposed to construct two distinct types of index. One will be of a familiar variety. It will express quantities of the output of agriculture in percentages of a fixed base; namely, the average of the crops of the last five pre-war years, 1909–13. In averaging these relatives, the geometric mean will be used.[2] The several commodities comprised in the index will be weighted according to their respective economic importance as evidenced in the average annual values of the individual crops during the same base period, 1909–13. The first index will thus be a weighted geometric mean of relatives calculated with the average of 1909–13 as a base. This index will be referred to as the unadjusted index.

The other index will be of an entirely different sort. It is obvious that the first type of index does not take into account at all the normal increase which practically all the crops show over the years. The steadiness of the growth shown by the total production of some of the more important crops is a striking feature of the data.

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[1] These three divisions are the only ones that will be covered in any way by the present study. It is hoped, however, that the material will in time permit the addition of the divisions of animal husbandry and forestry.

[2] This mean is adopted for two reasons: (1) it reduces somewhat the influence of extreme items — a considerable advantage in constructing a fixed-base index; and (2) it makes it possible to shift the base of the index freely without recalculation of the averages — a possibility which will be valuable in later parts of the present study. See W. C. Mitchell in "Index Numbers of Wholesale Prices in the United States and Foreign Countries." *Bulletin of the U. S. Bureau of Labor Statistics*, No. 173.

Where such a growth element exists, it substantially affects the interpretation of any increase or decrease in the output of a given year. Increases which are but normal may be said to require no readjustment of business factors. Upon the other hand, increases which are either greater or less than those to be expected bring new influences into the economic situation. Under this conception the original items are to be analyzed in terms of their deviations from the prevailing norms of production. An index to register such deviations promises to throw new light upon changes in the physical volume of production.

The second type of index in the present study is designed to measure the physical volume of production with due allowance for those changes which may be regarded as normal. The first step in the construction of this index will be the determination of the secular trends of the several individual series. The original items will then be expressed as percentages of the corresponding ordinates of the lines of secular trend. A weighted arithmetic mean of these percentages finally will be secured. The weights employed will be the same as in the first type of index — the average annual value of the production of the several individual commodities for the five-year period, 1909–13. This index, quite different from the first and to be differently interpreted, will be referred to as the adjusted index.

Material Utilized

The individual series employed in Part I of the present study comprise the twelve most important crops for which data are continuously available from 1879 to date. These twelve crops are: hay, corn, oats, wheat, barley, rye, rice, white potatoes, sugar, tobacco, cotton, and flaxseed.[1] All the more important agricultural products are included.[2] It will contribute to an effective and reliable use of the agricultural indices if the nature of the different crop series, the commercial utilization of the crop, and the geographic distribution of its production are first briefly reviewed.

Hay. The series is of tame hay; i. e., primarily timothy, clover, alfalfa, millet and Hungarian grass. During recent years, data on wild hay have also been collected. Hay is almost unknown in foreign commerce but is shipped extensively in domestic trade. Production of hay is widespread but centers in the corn belt of the Mississippi valley.

Corn. The series used is the total, not the merchantable, crop. On the average, perhaps 82 per cent of the crop is merchantable.[3] Corn is known as "the king of forage crops" and in the United States has a greater aggregate value than any other crop grown. Of the total production of corn in this country, about four-fifths is for direct consumption on the farm, only about one-fifth for general trade. Three-fourths of the American corn crop is raised in the corn belt of the upper Mississippi valley but the cereal is also grown extensively in the cotton belt of the South.

Oats. This crop is used principally for feed for horses, less than one-thirtieth of the total crop in this country being converted into human food. The small exports are in the form of oatmeal. Oats are grown largely in the corn belt of the upper Mississippi valley, and in other regions in which corn is an important product.

Wheat. Practically the entire wheat crop is used in milling flour. The great bulk of it enters commerce. It is by far our most important cereal food crop. Wheat in this country is grown chiefly on the central plains and in the Columbia basin.

Barley. This cereal is used largely for stock feed and in making malt for beer. The popularity of barley for stock feed has greatly increased during the past fifteen years. Most of the barley crop is produced in California, Minnesota, and the Dakotas.

Rye. Rye is a food grain resembling wheat but hardier. During recent years two-thirds of the crop in the United States has been consumed in feeding farm animals; practically all the remainder in the production of alcohol. Rye is grown chiefly in the Appalachian region, Minnesota, and the Dakotas.

Rice. The series used is of the rough, or unpolished, rice. One barrel of rough rice (3.6 bushels, or 162 pounds) produces 100 pounds of clean rice. Like wheat, rice is a cereal grown almost exclusively for human food. Practically the entire crop enters commerce, as only relatively small quantities are consumed as food on the farm or fed to live stock. The largest rice-producing region in the United States is on the western Gulf coast, but South Carolina, Georgia, and California also grow considerable amounts.

White Potatoes. In the United States, the white potato is entirely a food vegetable. A substantial proportion of the crop is consumed where grown. Cultivation of white potatoes is distributed through every state in the country, but the northern and northeastern sections offer the most favorable conditions.

Sugar. This series combines production and import figures. Imports from Porto Rico, Hawaii, and the Philippines for the fiscal year beginning July 1 are added to the combined beet and cane sugar crops of continental United States. In this way a figure is obtained approximating the total production of sugar in both contiguous and non-contiguous United States.[4]

The growing of sugar cane in continental United States is practically confined to Louisiana, with Texas the only other producing state worthy of mention. The largest producers of sugar beets in 1919 were Colorado, Michigan, Utah, and California. The cultivation of sugar beets has showed a rapid increase during recent years.

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[1] The only other series for which data are available for the period from 1879 to date is buckwheat. This is omitted because of its relative unimportance throughout the period and its failure to show any considerable increase during recent years. Its inclusion would not affect either index perceptibly.

[2] It is to be regretted, nevertheless, that data are not at hand for the years 1879–1920 for such crops as sweet potatoes, dried beans, peanuts, apples, peaches, and oranges. Production of these crops is now reported annually, but the reports do not run far enough back to warrant their inclusion in the present study. It is hoped later to construct an index of physical production of recent years that will include a more numerous list of agricultural products.

[3] The most valuable source of information regarding our food crops is J. Russell Smith's *The World's Food Resources*.

[4] There has seemed to be no other way of securing the desired series, since production figures for the insular possessions are not available for the period of this study.

Tobacco. Personal consumption accounts for most of this crop but some is used for plant disinfection and other relatively unimportant purposes. About three-fifths of the domestic crop is consumed in the United States. The crop is distinguished by a remarkable carry-over from year to year. Tobacco is grown east of the Mississippi. From 1914–18, the Central states grew 41 per cent of the crop; the South Atlantic, 36 per cent; the North Central, 14 per cent; and the North Atlantic, 9 per cent.

Cotton. Next to corn, cotton is the most valuable crop in the United States. About two-thirds of the world's supply is produced in this country. Practically all the cotton consumed in the United States is grown here, only small quantities being imported for special uses. Before the war, almost two-thirds of the crop was exported. More recently, more than one-half has been domestically consumed. The cotton belt extends from the Carolinas to Oklahoma and Texas. Formerly Louisiana, Mississippi, and Alabama showed the most concentrated production, but now "the bulk of the crop has moved westward into Texas, while the finer qualities have moved northwards" into the Central or Mississippi states.[1]

Flaxseed. Flax will yield fibre or seed, but not the full value of both from the same growth. In the United States, the crop is grown primarily for the seeds. These are consumed almost wholly in the production of linseed oil, with the one by-product, linseed cake, a valuable cattle food. Flax growing is now confined largely to the Dakotas, Montana, and Minnesota. Prolonged cultivation of flax tends to make the land "flax sick." The crop is satisfactorily grown on newly broken soil and hence heretofore has tended to move with the frontier.

Sources of Information

(a) *General*

The two government agencies which supply practically all the current data on agricultural production in the United States are the Bureau of Crop Estimates of the Department of Agriculture and the Bureau of the Census of the Department of Commerce.[2] With the exception of cotton, the work of the Bureau of the Census serves largely as a decennial check on the continuing annual reports of the Bureau of Crop Estimates. It is from this Bureau that the bulk of current information of agricultural output in the United States is now drawn.

The federal government's crop reporting service dates from 1862.[3] For the first twenty years, estimates were based upon reports made by unpaid correspondents. Ordinarily each county was covered by a chief and three or four assistants. Correspondents were selected on the recommendation of agricultural societies and members of Congress. The field returns, made to Washington by the county chiefs on blanks furnished by the Department of Agriculture, covered the condition of the crop, the average yield, the acreage and production.

In 1882, a staff of paid state agents was appointed. The idea was to obtain in this way a check on the reports of the county chiefs. The state agents promptly set up their own independent staffs of correspondents and the result was a virtual duplication of the original reporting system.

Still another staff of correspondents was organized during the 90's. The agricultural township or voting precinct was made the unit in this case. These township assistants made returns direct to the Department of Agriculture. At about the same time, selected lists of farmers, millers, grain elevator proprietors, and transportation companies were drafted into the Department's corps of direct correspondents.

A more important increase of the reporting staff than any of these, however, was made by the appointment in 1900 of salaried traveling field agents, charged with submitting estimates for the crops of assigned territories on the basis of personal observation and expert local opinion. This innovation led to a great improvement in the crop reporting service. So satisfactory has been the work of the traveling agents that the office of state agent, created in 1882, was abolished in 1915. A field agent is now appointed for each important state and for groups of the less important states. Furthermore, numerous salaried specialists now act similarly for individual crops: cotton, rice, tobacco, truck crops, and fruits.

Starting in 1862 with the single class of county correspondents, the crop-reporting service has grown to include, in addition to the county reporters, township correspondents, as many as fifteen lists of special reporters — such as dealers, elevator proprietors, and growers, traveling field agents, and crop specialists. The traveling agents and crop specialists are paid government employees; the others, unpaid volunteers. The territory covered by the service has been gradually extended until it now comprises practically all of continental United States in which there is any agricultural production.

The estimate of each total crop is derived by multiplying the acreage of the crop by the average yield per acre. The yield per acre is one of the items reported by the correspondents and field agents and is arrived at anew each year. Acreage, upon the other hand, is reported by the correspondents and agents as a percentage of the previous year's acreage. Once in ten years since

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[1] See J. A. Todd, *The World's Cotton Crops* (1915), p. 91.

[2] The data are conveniently reprinted, of course, in the *Statistical Abstract of the United States*, published by the Bureau of Foreign and Domestic Commerce of the Department of Commerce. In the present study all data have been taken from the original authorities. For recent years this makes comparatively little difference. During earlier years the discrepancies between original and secondary sources are frequent and important.

[3] For an excellent account of the service, see *Government Crop Reports, Circular 17*, Dept. of Agriculture (issued 1909, revised 1911 and 1918).

1879, the Department has brought its acreage figure into line with the Census farm enumeration of acreage. Any habitual error in the field returns of comparative acreage is thus cumulative between the decennial censuses of the Department of Commerce. Crop estimates therefore are probably least accurate in the later years of the decade. In general, however, the government's crop reports, while undoubtedly containing appreciable error, are sufficiently accurate for the purpose of constructing an index of the physical volume of agricultural production in the United States since 1879.

(b) *The Individual Series*

Hay, corn, oats, wheat, barley, rye, white potatoes.[1] The authoritative source for these series is the *Yearbook* of the Department of Agriculture. For any current year *estimates* of the more important crops are published in the *Monthly Crop Reporter* of the Department's Bureau of Crop Estimates.

The *Yearbook* for 1918 (pp. 448 *et seq.*) contains revised figures for all the crops of this group for the years 1879 and 1889–1909. These revised series differ from both the Department's original estimates and the census figures for census years. The only indication given of the basis of the revision of the production figures is in the following statement in the *Yearbook* for 1918 (p. 452): "This revision for 1879 and 1889–1909 consists (1) in using the Department of Agriculture's average yield per acre to compute, from census acreage, the total production; (2) in adjusting the Department's estimates of acreage for each year so as to be consistent with the following as well as the preceding census acreage." The revision, first published in the 1918 *Yearbook* and since followed, appears to have been the only extensive one undertaken, though in years near the decennial census, figures are usually stated to have been adjusted to the census basis.

The Department of Agriculture's revised figures have been uniformly adopted in the present study except for the year 1879. The revision for this earlier census year is isolated, no attempt having apparently been made to revise the original estimates for the years 1880–88. It has not been thought expedient, consequently, to insert the revised figures for 1879 in the series published by the Department. In all other cases, the revised figures are used.

Rice.[2] From 1904 to date, the Department has made estimates of the yearly production of rice under its regular crop reporting service. For this period, of course, the Department's figures are adopted. For years before 1904, the rice series is drawn from the estimates of marketed production compiled by Dan Talmage's Sons Company, and quoted in *Circular 34* of the Bureau of Statistics of the Department of Agriculture. This circular, however, quotes census figures for census years. It was thought best to use Talmage's Sons' estimates continuously. These estimates are given for cleaned rice in the *Statistical Abstract.* The corresponding figures for rough rice in census years 1879–99 are obtained by applying a conversion factor based upon the following standard proportions:

100 lbs. clean rice = 162 lbs. of rough.
162 lbs. rough = 1 bbl. = 3.6 bu.
1 bu. rough = 45 lbs.

Sugar. The sugar series, as already stated, combines production and import figures, and is taken directly from the *Statistical Abstract.* Data on cane sugar production are drawn by the *Abstract* from the census reports in census years, from A. Bouchereau for intercensal years to 1903, from Willet & Gray beginning with 1903–04. Beet sugar production figures are from Willet & Gray for all years except 1898 and 1902 to date, when Department of Agriculture estimates are quoted. Data on sugar imports come originally, of course, from the commerce reports of the Bureau of Foreign and Domestic Commerce.

Tobacco. This series for the years 1879–98, is taken from *Circular 33* (1912) of the Bureau of Statistics of the Department of Agriculture — "Tobacco Crop of the United States, 1612–1911." For the years 1899 to date, the series is transcribed from the *Yearbook* (1919) of the Department. The data from 1900 to date represent estimates made by the Department's regular crop reporting service. The figures for 1879 and 1899 were derived originally from the census reports. For the years 1880–98, the figures were computed by adding the net exports of unmanufactured tobacco to the amounts on which the internal revenue tax was paid. In the opinion of the Office of the Commissioner of Internal Revenue this method gives results which are as complete and correct as any that can now be compiled.

Cotton. The Census Bureau reports on *Cotton Production* are universally accepted as the final authority on this crop in the United States from 1899 to date. For the years prior to 1899, reports of the Department of Agriculture are usually cited. Examination of these discloses a number of conflicting estimates. The figures used in the present study for the years 1879–98 have been recently supplied in a letter from the present chief of the Bureau of Crop Estimates, Mr. L. A. Estabrook. These figures are said to represent the best present estimates.

Flaxseed. This crop was brought within the reporting service of the Department of Agriculture in 1902. From that year to date, the flaxseed series consists of the Department's estimates. The reports of the Bureau of the Census are the original source of the figures for 1879, 1889, 1899. For intercensal years from 1880–1901 inclusive, the series is from the *Statistical Abstract* which in turn refers its figures to "reports of the Department of Agriculture."

The records of the crops of these twelve important commodities from 1879 to 1920 constitute the material

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[1] For a special report on the production of potatoes see *Bulletin 695* (1918) of the Department of Agriculture.

[2] For comprehensive historical studies of rice cultivation in the United States, see Dept. of Agriculture, Division of Statistics, Misc. Series, *Report No. 6* (1893) and *Circular 34* (1912) of the Bureau of Statistics of the Department.

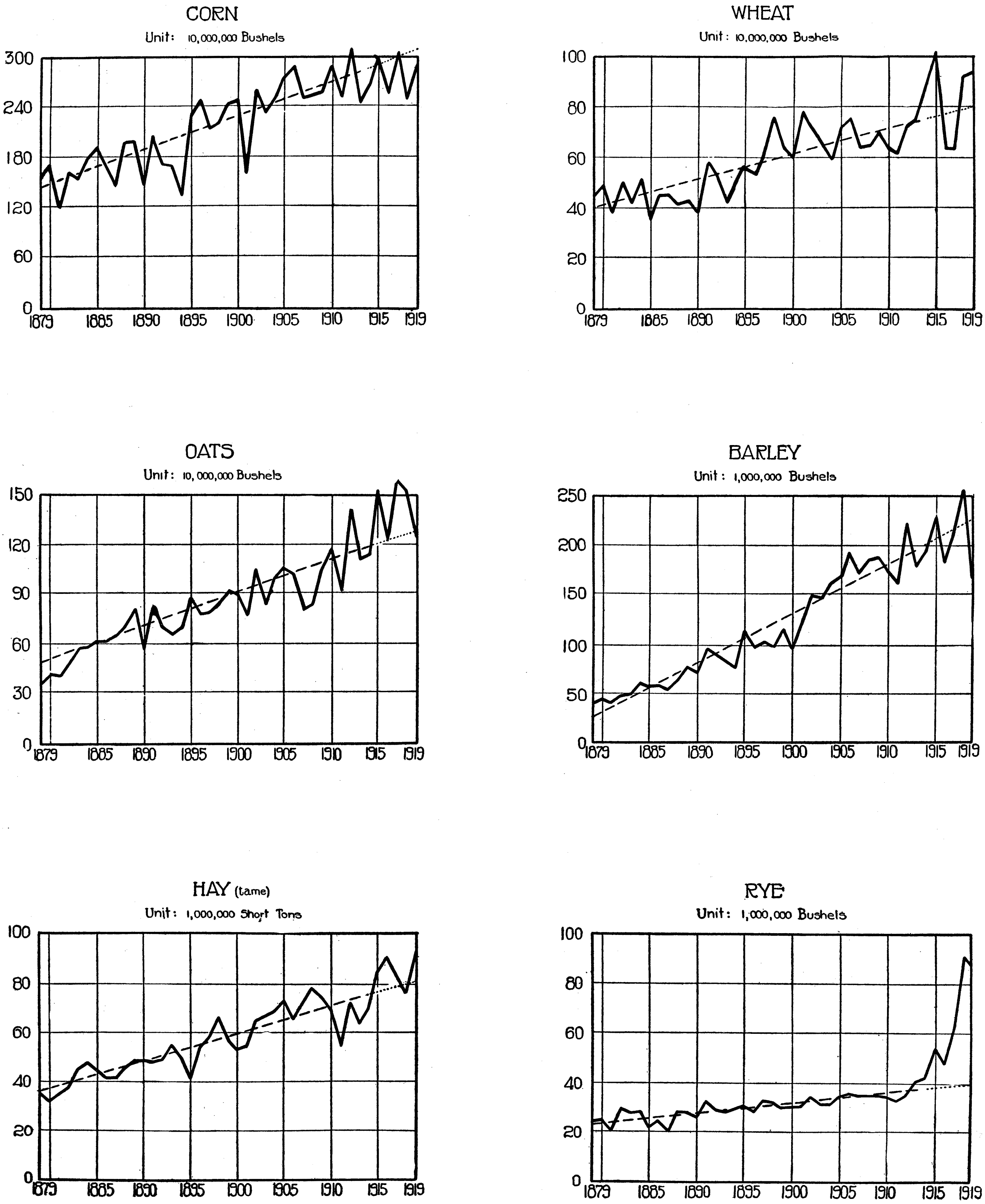
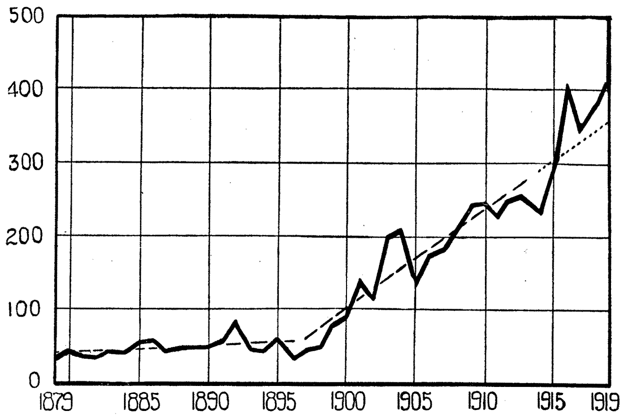
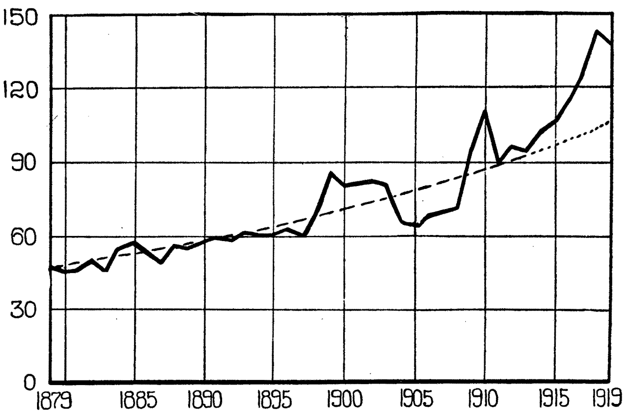


Chart I. — Annual Physical Production of Corn, Wheat, Oats, Barley, Hay, and Rye, 1879–1919, Together with Lines of Secular Trend.

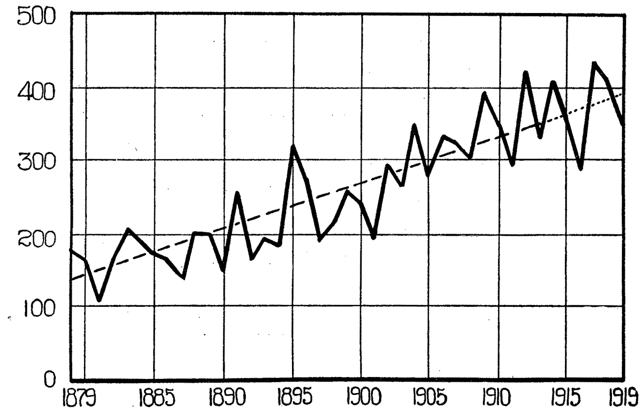
RICE (rough)
Unit 100,000 Bushels



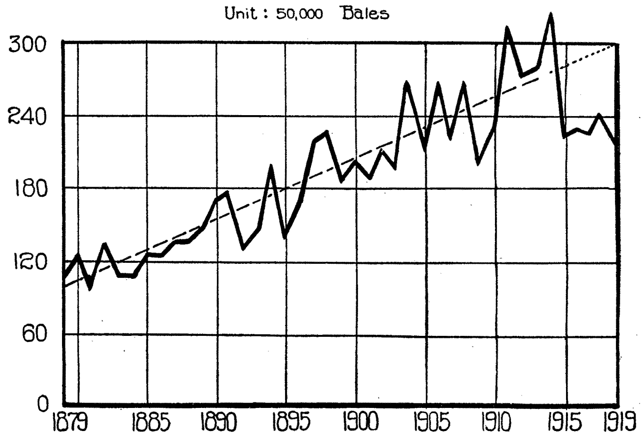
TOBACCO
Unit: 10,000,000 Pounds



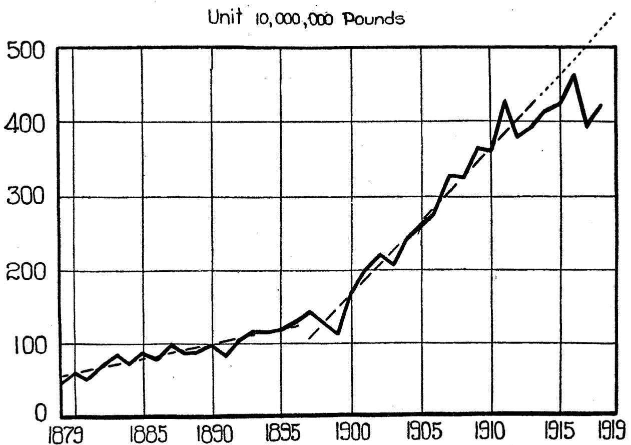
WHITE POTATOES
Unit: 1,000,000 Bushels



COTTON
Unit: 50,000 Bales



SUGAR
Unit 10,000,000 Pounds



Production of cane and beet sugar in continental United States, plus imports from non-contiguous United States during fiscal years beginning July 1

FLAXSEED
Unit: 100,000 Bushels

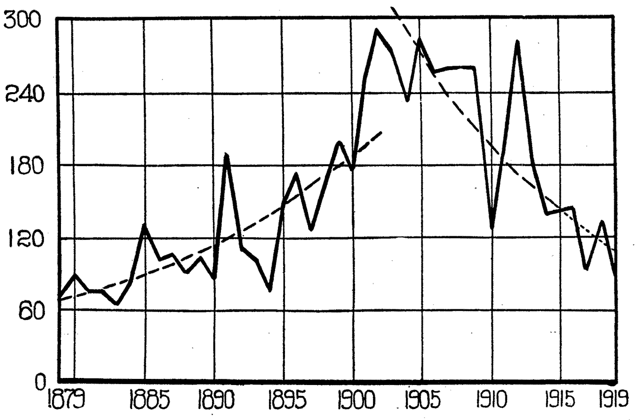


CHART II. — ANNUAL PHYSICAL PRODUCTION OF RICE, TOBACCO, WHITE POTATOES, COTTON, SUGAR, AND FLAXSEED, 1879–1919, TOGETHER WITH LINES OF SECULAR TREND.

from which the two types of index of physical volume of agricultural production are constructed. The twelve series are given below in Table I, and plotted separately in the diagrams of Charts I and II.

The Unadjusted Index

The first step in the construction of the unadjusted index consists of the calculation of the average of the

Table I. — Annual Physical Production for Twelve Important Crops, 1879–1919 *

Year	Hay (tame) *mill'n sh. tons*	Corn *million bu.*	Oats *million bu.*	Wheat *million bu.*	Barley *million bu.*	Rye *million bu.*	Rice (rough) † *million bu.*	White potatoes *million bu.*	Sugar ‡ *million lbs.*	Tobacco *million lbs.*	Cotton ¶ *million bales*	Flaxseed *million bu.*
1879	35.49	1548	364	448.8	40.3	23.64	3.08	181.6	460	473	5.47	7.17
1880	31.92	1717	418	498.6	45.2	24.54	4.03	167.7	604	455	6.36	9.00
1881	35.14	1195	416	383.3	41.2	20.70	3.69	109.1	521	457	5.15	7.50
1882	38.14	1617	488	504.2	49.0	29.97	3.60	171.0	707	503	6.83	7.50
1883	46.86	1551	571	421.1	50.1	28.06	3.98	208.2	863	451	5.52	6.50
1884	48.47	1796	584	512.8	61.2	28.64	3.95	190.6	737	559	5.50	8.50
1885	44.73	1936	629	357.1	58.4	21.76	5.41	175.0	881	588	6.37	13.00
1886	41.80	1665	624	457.2	59.4	24.49	5.60	168.1	789	544	6.32	10.00
1887	41.45	1456	660	456.3	56.8	20.69	4.09	134.1	996	485	6.88	10.50
1888	46.64	1988	702	415.9	63.9	28.41	4.49	202.4	860	570	6.92	9.00
1889	49.18	1999	802	434.4	78.2	28.38	4.74	201.2	867	555	7.47	10.25
1890	49.06	1460	573	378.1	73.0	26.41	4.92	150.5	990	578	8.56	8.50
1891	48.76	2056	839	584.5	96.6	32.76	5.60	256.1	823	590	8.94	19.00
1892	49.24	1714	695	528.0	92.0	29.25	8.55	164.5	1037	588	6.65	11.10
1893	55.58	1708	676	427.6	83.7	28.59	4.42	195.0	1182	622	7.48	10.00
1894	50.47	1340	716	516.5	78.0	29.61	3.95	183.8	1174	610	10.01	7.50
1895	41.84	2311	886	569.5	114.7	31.14	6.07	317.1	1188	612	7.14	15.00
1896	54.38	2503	781	544.2	99.4	28.91	3.49	271.8	1319	632	8.51	17.40
1897	58.88	2145	792	610.2	103.3	33.43	4.19	191.0	1426	611	10.97	12.50
1898	66.77	2261	843	772.2	99.5	32.89	4.93	218.8	1263	698	11.42	16.40
1899	57.45	2455	926	636.1	116.6	30.33	7.90	260.3	1113	868	9.34	19.98
1900	53.23	2505	905	602.7	96.0	30.79	9.11	247.8	1629	814	10.12	17.59
1901	55.82	1607	778	789.5	121.8	31.10	13.97	198.6	2014	819	9.51	25.32
1902	65.30	2621	1055	724.5	149.4	35.26	11.50	293.9	2202	822	10.63	29.28
1903	68.15	2339	849	664.5	146.9	31.99	20.19	262.0	2064	816	9.85	27.30
1904	69.19	2521	1007	596.4	162.1	31.81	21.10	352.3	2450	660	13.44	23.40
1905	72.97	2744	1069	726.4	170.2	35.17	13.61	278.9	2618	633	10.58	28.48
1906	66.34	2895	1035	757.2	192.3	36.56	17.86	331.7	2766	682	13.27	25.58
1907	72.26	2512	807	638.0	170.0	35.46	18.74	322.9	3301	698	11.11	25.85
1908	78.44	2545	847	644.7	184.9	35.77	21.89	302.0	3276	718	13.24	25.80
1909	74.38	2572	1068	700.4	188.0	35.41	24.37	394.6	3631	949	10.00	25.86
1910	69.38	2886	1186	635.1	173.8	34.90	24.51	349.0	3618	1103	11.61	12.72
1911	54.92	2531	922	621.3	160.2	33.12	22.93	292.7	4296	905	15.69	19.37
1912	72.69	3125	1418	730.3	223.8	35.66	25.05	420.6	3764	963	13.70	28.07
1913	64.12	2447	1122	763.4	178.2	41.38	25.74	331.5	3941	854	14.16	17.85
1914	70.07	2673	1141	891.0	195.0	42.78	23.65	409.9	4134	1035	16.14	13.75
1915	85.92	2995	1549	1025.8	228.8	54.05	28.95	359.7	4230	1062	11.19	14.03
1916	91.19	2567	1252	636.3	182.3	48.86	40.86	287.0	4671	1153	11.45	14.30
1917	83.31	3065	1593	636.7	211.8	62.93	34.74	442.1	3950	1249	11.30	9.16
1918	76.66	2503	1538	921.4	256.2	91.04	38.61	411.9	4220	1439	12.04	13.37
1919	91.33	2917	1248	941.0	165.7	88.48	41.06	357.9	....	1390	11.42	8.92
1920 §	88.17	3131	1442	770.0	194.9	77.89	52.15	412.9	....	1554	12.78	11.82

* Latest revised figures have been used in all cases, except for the year 1879. Lack of a continuous revision from 1879–88 makes the use of the revised figure for this one year seem inadvisable.

† For the years 1879–1903, original estimates in barrels of rice were corrected at the rate 1 bbl. = 3.6 bu.

‡ These figures represent total production of beet and cane sugar in contiguous United States for the crop year indicated, plus imports from noncontiguous United States for the fiscal year beginning July 1 of the crop year. Imports are "exclusive of small amounts coming from Alaska, and involved in Samoan commerce, and in the fiscal years 1917, 1918, and 1919, of sugar which came from the Virgin Islands, 26,406,776 pounds, . . . 23,921,591 pounds, . . . and 18,055,674 pounds, . . . respectively." *Statistical Abstract*, 1919, p. 544.

§ September 1 estimates.

¶ Bales of 500 lbs. gross weight.

items of each series for the five years, 1909–13. The years 1909–13 are made a base period because they were the last five years of normal production before the war. Furthermore the period 1909–13 possesses the advantage of including the most recent year, 1909, in which a census of manufactures has been taken under fairly representative conditions.[1]

The averages for the base period having been determined, the next step is to express the items of the several series as percentages of their respective base-period averages. At this point, differences among the

TABLE II. — RELATIVE ANNUAL PHYSICAL PRODUCTION FOR TWELVE IMPORTANT CROPS, 1879–1920

(*Base: 1909–13*)

Year	Hay	Corn	Oats	Wheat	Barley	Rye	Rice	White potatoes	Sugar	Tobacco	Cotton	Flaxseed
	mill'n sh. tons	*million bu.*	*million bu.*	*million bu.*	*million bu.*	*million bu.*	*million bu.*	*million bu.*	*million lbs.*	*million lbs.*	*mill'n bales**	*million bu.*
1909–13 (average)	67.10	2712	1143	690.1	184.8	36.09	24.52	357.7	3850	974.9	13.03	20.77
1879	52.9	57.1	31.8	65.0	21.8	65.6	12.6	50.8	11.9	48.5	42.0	34.5
1880	47.6	63.3	36.5	72.3	24.4	68.0	16.4	46.9	15.7	46.7	48.8	43.3
1881	52.4	44.1	36.4	53.3	22.3	57.4	15.1	30.5	13.5	46.8	39.5	36.1
1882	56.8	59.6	42.7	73.0	26.5	83.1	14.7	47.8	18.4	51.6	52.4	36.1
1883	69.8	57.2	50.0	61.0	27.1	77.8	16.2	58.2	22.4	46.3	42.4	31.3
1884	72.2	66.2	51.0	74.2	33.1	79.4	16.1	53.3	19.1	57.4	42.1	41.0
1885	66.7	71.4	55.0	51.7	31.6	60.3	22.1	48.9	22.9	60.4	48.9	62.6
1886	62.3	61.4	54.6	66.1	32.2	67.9	22.8	47.0	20.5	55.8	48.4	48.2
1887	61.8	53.7	57.7	66.0	30.7	57.4	16.7	37.5	25.9	49.7	52.8	50.6
1888	69.5	73.3	61.4	60.1	34.6	78.7	18.3	56.6	22.3	58.4	53.1	43.3
1889	73.3	73.7	70.1	62.9	42.3	78.7	19.3	56.2	22.5	56.9	57.3	49.4
1890	73.1	53.8	50.1	54.8	39.5	73.2	20.1	42.1	25.7	59.3	65.6	41.0
1891	72.7	75.8	73.4	84.5	52.2	90.8	22.9	71.6	21.4	60.5	68.5	91.5
1892	73.4	63.2	60.8	76.4	49.8	81.1	34.9	46.0	26.9	60.3	51.0	53.5
1893	82.8	63.0	59.1	62.0	45.3	79.2	18.0	54.5	30.7	63.7	57.4	48.2
1894	75.2	49.4	62.6	74.8	42.2	82.0	16.1	51.4	30.5	62.6	77.0	36.1
1895	62.4	85.2	77.5	82.5	62.1	86.3	24.8	88.6	30.8	62.6	54.8	72.2
1896	81.0	92.3	68.3	78.8	53.8	80.1	14.2	76.0	34.3	64.8	65.2	83.8
1897	87.8	79.1	69.2	88.3	55.9	92.7	17.1	53.4	37.1	62.7	84.2	60.2
1898	99.5	83.4	73.7	111.9	53.8	91.2	20.1	61.2	32.8	71.6	87.6	79.0
1899	85.6	90.5	80.9	92.0	63.1	84.1	32.2	72.8	28.9	89.0	71.7	96.2
1900	79.3	92.4	79.1	87.4	52.0	85.3	37.1	69.3	42.3	83.5	77.7	84.7
1901	83.2	59.3	68.1	114.4	65.9	86.2	56.9	55.5	52.2	84.0	73.0	121.9
1902	97.3	96.6	92.3	105.0	80.8	97.7	46.9	82.2	57.2	84.3	81.6	141.0
1903	101.6	86.2	74.2	96.2	79.5	88.6	82.3	73.2	53.6	83.7	75.6	131.5
1904	103.1	92.9	88.1	86.3	87.7	88.1	86.0	98.5	63.7	67.7	103.1	112.7
1905	108.7	101.2	93.5	105.1	92.1	97.3	55.6	78.0	67.6	64.9	81.1	137.1
1906	98.9	106.7	90.5	109.5	104.0	101.4	72.8	92.7	71.8	70.0	101.9	123.1
1907	107.7	92.6	70.6	92.4	92.0	98.4	76.3	90.3	85.8	71.6	85.2	124.5
1908	116.9	93.8	74.1	93.2	100.0	99.2	89.2	84.4	85.0	73.6	101.6	124.2
1909	110.8	94.8	93.4	101.5	101.7	98.2	99.4	110.3	94.4	97.4	76.7	124.5
1910	103.4	106.4	103.7	92.0	94.1	96.8	99.9	97.6	93.9	113.2	89.1	61.2
1911	81.8	93.3	80.6	90.0	86.7	91.8	93.6	81.8	111.6	92.8	120.4	93.2
1912	108.3	115.2	124.0	105.7	121.1	98.7	102.2	117.6	97.9	98.8	105.1	134.8
1913	95.6	90.2	98.1	110.5	96.4	114.8	104.9	92.7	102.4	97.8	108.6	86.0
1914	104.4	98.6	99.8	129.0	105.5	118.6	96.3	114.6	107.4	106.1	123.8	66.5
1915	128.0	110.4	135.5	148.6	123.8	149.7	118.0	100.6	110.0	108.9	85.9	67.4
1916	135.9	94.6	109.5	92.2	98.6	135.4	166.6	80.2	121.3	118.3	87.8	68.8
1917	124.1	113.0	139.3	92.4	114.6	174.3	141.5	123.2	102.6	128.1	86.7	44.1
1918	114.2	92.3	134.5	133.4	138.7	252.2	157.5	115.1	109.5	147.6	92.4	64.4
1919	136.1	107.5	109.2	136.4	89.7	245.1	167.5	100.1	....	142.5	87.6	42.9
1920	131.4	115.4	126.1	111.6	105.5	215.8	212.5	115.5	....	159.4	98.0	56.9

* Bales of 500 lbs. gross weight.

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[1] The advantage of this will appear in a later part of the study.

series begin to appear sharply. Rice shows the largest proportionate increase from 1879 to 1920, 12.6 per cent to 212.5 per cent; and flaxseed, the smallest, 34.5 per cent to 56.9 per cent. The percentages series, and the averages of the original items for the years 1909–13, are given for all twelve of the crops, in Table II.

The several crops in the group of twelve obviously are not all of the same significance. A 10 per cent increase in the production of wheat is of much greater importance to the country than an equal percentage increase in the production of rice. A method of weighting the relatives is required. The relative importance of the twelve crops in the economic life of the country may be said to be registered in their respective annual aggregate values. The method of weighting adopted assigns weights corresponding to the average annual values of the individual crops for the five-year base period, 1909–13. These annual values and their averages are given in Table III. The items of the first column, taken to the nearest unit, are the required weights.

TABLE III. — ANNUAL AGGREGATE VALUES OF TWELVE IMPORTANT CROPS, 1909–13

(*Unit: $1,000,000*)

Crop	Average of five years 1909–13	1909	1910	1911	1912	1913
Corn	1563.1	1652.8	1384.8	1565.3	1520.5	1692.1
Cotton *	919.9	812.1	963.2	859.8	920.6	1043.8
Hay	757.1	689.3	747.8	694.6	856.7	797.1
Wheat	599.9	730.0	561.1	543.1	555.3	610.1
Oats.	424.7	408.2	408.4	414.7	452.5	439.6
White Potatoes . . .	215.1	206.5	194.6	233.8	212.6	227.9
Sugar.	156.6	145.4	151.6	191.3	156.8	138.2
Barley	108.5	94.0	100.4	139.2	113.0	95.7
Tobacco	101.9	95.7	102.1	85.2	104.1	122.5
Flaxseed	31.6	39.5	29.5	35.3	32.2	21.4
Rye	25.2	23.8	25.0	27.6	23.6	26.2
Rice	19.6	17.4	16.6	18.3	23.4	22.1

* Including cottonseed.

The final step in the construction of the unadjusted index is to obtain a weighted average of the twelve percentage relatives for each year of the period from 1879 to 1920. The average employed is the geometric mean.[1] While this is much less familiar than the arithmetic mean and the median, and considerably more laborious to compute, its technical qualities, already explained,[2] give it advantages which are decisively in its favor in the present study.

The weighted geometric means of the twelve percentage relatives constitute the unadjusted index of physical volume. This index for agricultural production in the United States for the years 1879–1920, is given in full in Table IV and shown graphically in Chart III. Both table and chart show clearly the striking increase which has occurred in the physical volume of agricultural production during the past forty-one years. In addition, the marked variations in the physical volume of production from year to year are thrown into relief. Agricultural production in 1881, 1890, 1892, 1893, 1894, 1901, 1907, 1911, 1913, was markedly low. In 1891, 1898, 1902, 1906, 1912, and 1915, it was as distinctly high. The current year, 1920, promises to set a new high record, though it will probably be but slightly higher than the remarkable showings of 1912 and 1915.

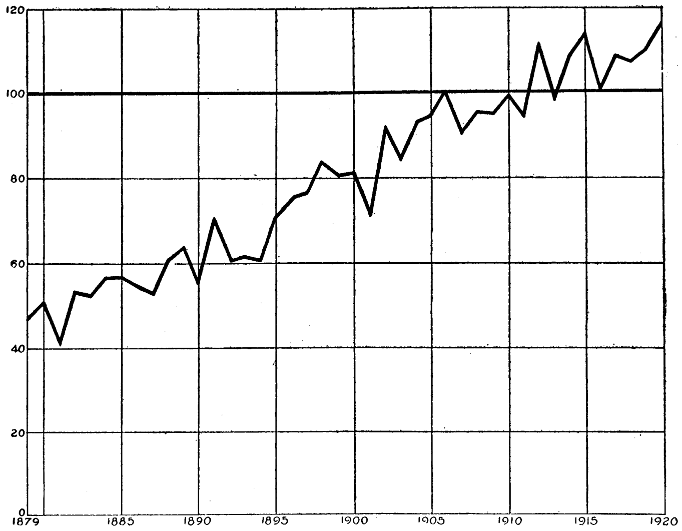

CHART III. — UNADJUSTED INDEX OF PHYSICAL PRODUCTION FOR AGRICULTURE, 1879–1920
(*Base: 1909–13*)

TABLE IV. — UNADJUSTED INDEX OF PHYSICAL PRODUCTION FOR AGRICULTURE 1879–1920

(*Base: 1909–13*)

Year	Index	Year	Index
1879	47.1	1900	80.9
1880	51.0	1901	71.8
1881	41.5	1902	91.4
1882	53.3	1903	84.4
1883	52.5	1904	93.3
1884	56.7	1905	94.5
1885	57.1	1906	100.5
1886	54.9	1907	90.4
1887	53.3	1908	95.5
1888	60.8	1909	95.0
1889	63.7	1910	99.1
1890	55.8	1911	94.1
1891	70.4	1912	111.0
1892	60.3	1913	98.2
1893	61.4	1914	108.5
1894	60.5	1915	113.4
1895	70.3	1916	100.4
1896	75.7	1917	108.5
1897	76.7	1918	107.1
1898	83.4	1919	110.6
1899	80.4	1920	115.2

The question may be raised whether the increase in the physical volume of agricultural production as shown by the unadjusted index for the period 1879–1920 is

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[1] The usual formula for the geometric mean is

$$M_G = \sqrt[n]{a_1 \cdot a_2 \cdot a_3 \cdot \ldots a_n}$$

where a_1, a_2, a_3 . . . a_n are the items to be averaged and n their number. When weights are introduced the formula becomes:

$$M_G = \sqrt[(w_1 + w_2 + \ldots w_n)]{a_1^{w_1} \cdot a_2^{w_2} \cdot a_3^{w_3} \cdot \ldots a_n^{w_n}}$$

where w_1, w_2, w_3 . . . w_n are the weights of a_1, a_2, a_3, . . . a_n, respectively.

[2] See p. 247, *supra*.

greater or less proportionately than the increase of population during the same period. To facilitate the comparison, it is desirable to use both the population and the agricultural production of 1879, the starting point, as a base, or 100 per cent. The unadjusted index of agricultural production, having been constructed as a geometric mean, is readily shifted to this new base by making the index of 1879, 47.1, equal 100 and expressing the indices of all the other years as percentages of this as a base. The corresponding population relatives are easily obtained by expressing the population of the years 1880–1920 as percentages of the population of 1879. These population figures, both absolute and relative, and the unadjusted index shifted to 1879 as a new base, are shown in Table V.

The same data of population and agricultural production are exhibited in Chart IV. There are also shown in the chart the secular trends of the unadjusted index, first for the period 1879–96, and second, for the period 1897–1913, extended to 1920. The parallelism between the lines of secular trend and the line of proportionate population increase is striking. It is clear enough that the physical volume of agricultural production, while following closely the line of population growth, has upon the whole slightly exceeded it.

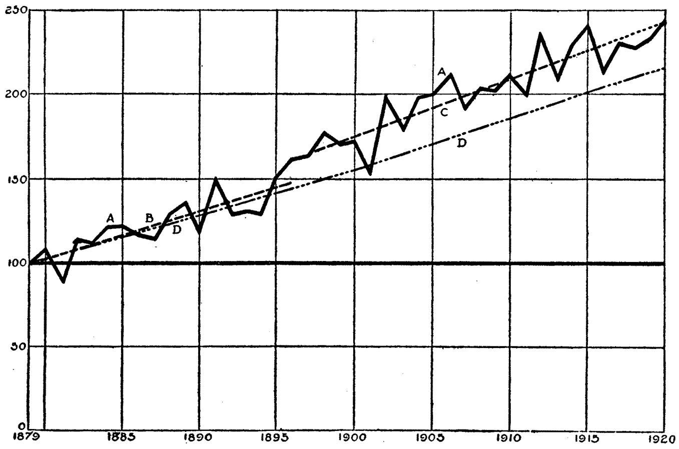

Chart IV. — Unadjusted Index of Physical Production for Agriculture, 1879–1920, Together with Lines of Secular Trend and Index of Population.

(*Base: 1879*)

(A) Unadjusted index of physical production for agriculture.
(B) Line of secular trend fitted to the index for 1879–96.
(C) Line of secular trend fitted to the index for 1897–1913.
(D) Index of population.

Table V. — Unadjusted Index of Physical Production for Agriculture, compared with Index of Population, 1879–1920

(*Base: 1879*)

Year	Population of Continental United States *million persons*	Index of population	Index of physical production for agriculture
1879	49.00	100.0	100.0
1880	50.16	102.5	108.3
1881	51.43	105.0	88.1
1882	52.71	107.6	113.1
1883	53.99	110.2	111.5
1884	55.27	112.8	120.4
1885	56.55	115.4	121.3
1886	57.83	118.1	116.6
1887	59.11	120.7	113.2
1888	60.39	123.2	129.2
1889	61.67	125.8	135.4
1890	62.95	128.5	118.4
1891	64.25	131.1	149.4
1892	65.56	133.4	128.1
1893	66.86	136.4	130.4
1894	68.17	139.2	128.5
1895	69.47	141.7	149.4
1896	70.78	144.4	160.7
1897	72.08	147.1	162.9
1898	73.39	149.6	177.1
1899	74.69	152.4	170.9
1900	75.99	155.1	171.7
1901	77.59	158.3	152.5
1902	79.19	161.5	194.0
1903	80.79	164.8	179.3
1904	82.39	168.2	198.1
1905	83.98	171.4	200.6
1906	85.58	174.6	213.3
1907	87.18	177.9	192.0
1908	88.78	181.2	202.8
1909	90.37	184.4	201.7
1910	91.97	187.6	210.5
1911	93.57	191.0	199.9
1912	95.17	194.2	235.8
1913	96.77	197.5	208.5
1914	97.94	199.9	230.5
1915	99.12	202.3	240.9
1916	100.29	204.7	213.2
1917	101.47	207.1	230.2
1918	102.65	209.5	227.4
1919	103.82	211.9	234.8
1920	105.00	214.3	244.6

The Adjusted Index

The first step in the construction of the adjusted index is the determination of the secular trends of the twelve original crop series. The methods employed are those already familiar to readers of the Review through the work of Professor Persons.[1] For most of the series in the group of twelve important crops, the trends are continuous for the entire pre-war period, 1879–1913, and are of the simple linear type. Straight lines fitted to the data from 1879 to 1913 give entirely satisfactory results. In a few cases resort has to be made to the compound interest curve, and in one case, flaxseed, the period of fit has to be extended through the war. In all other cases except flaxseed, it has been thought best not to include the years 1914–20 in determining the secular trend. The lines of secular trend are all plotted upon the individual crop diagrams of Charts I and II,

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[1] For the explanation of these methods, see The Review of Economic Statistics, January, 1919, pp. 8–18.

TABLE VI. — SECULAR TREND FOR TWELVE IMPORTANT CROPS, 1879–1913

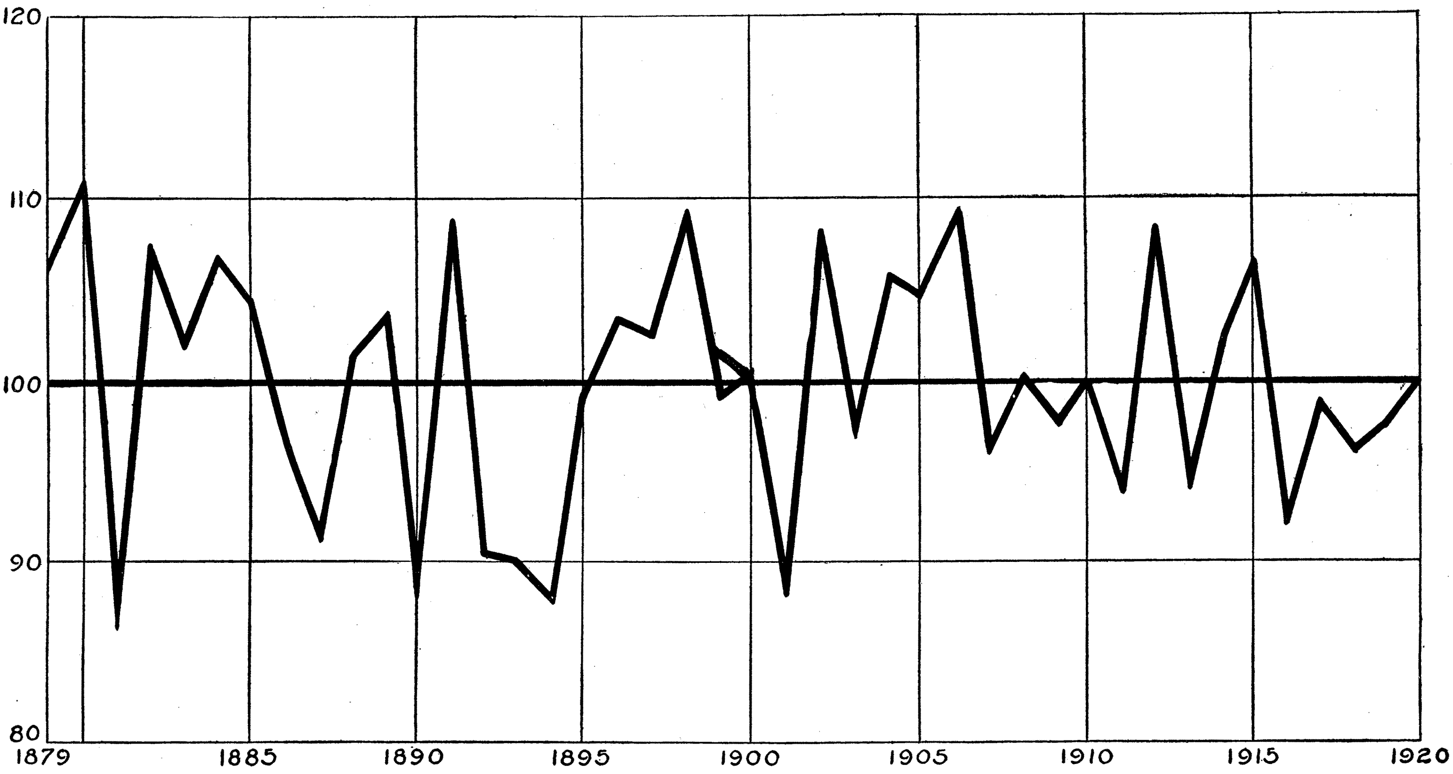
Commodity	Unit: millions of	Line of Secular Trend			Normal crop 1913	Normal annual increase
		Equation	Period for which fitted	Origin		
Hay	Short tons	$y = 1.104x + 55.13$	1879–1913	1896	73.9	1.104
Corn	Bushels	$y = 40.9x + 2122.$	1879–1913	1896	2818.0	40.90
Oats	Bushels	$y = 20.37x + 801.5$	1879–1913	1896	1147.8	20.37
Wheat	Bushels	$y = 10.03x + 572.8$	1879–1913	1896	743.3	10.03
Barley	Bushels	$y = 4.93x + 110.8$	1879–1913	1896	194.5	4.93
Rye	Bushels	$y = 0.403x + 30.49$	1879–1913	1896	37.3	0.403
Rice	Bushels	$y = 0.1012x + 4.649$	1879–1896	1887–88*		0.101
		$y = 1.341x + 16.92$	1897–1913	1905	27.6	1.341
White potatoes	Bushels	$y = 6.41x + 242.8$	1879–1913	1896	351.8	6.41
Sugar	Pounds	$y = 41.16x + 888.8$	1879–1896	1887–88*		41.16
		$y = 194.0x + 2668.9$	1897–1913	1905	4220.9	194.00
Tobacco	Pounds	$y = (654.2)(1.021)^x$	1879–1913	1896	930.5	†
Cotton	Bales	$y = 0.254x + 9.278$	1879–1913	1896	13.6	0.254
Flaxseed	Bushels	$y = (11.74)(1.025)^x$	1879–1902	1890–91*		‡
		$y = (18.33)(.936)^x$	1903–1919	1911	16.1	§

* Midway between the two years indicated. † Shows annual increase of 2.1 per cent. ‡ Shows annual increase of 2.5 per cent.
§ Shows annual *decrease* of 6.4 per cent.

where the closeness of fit of the lines may be readily observed. The equations of the lines of secular trend, together with the annual increase or decrease and the 1913 total which each equation implies, are given in Table VI.

The lines of secular trend having been determined, the next step is to express every item of each crop series as a percentage of the corresponding ordinate of the line of the series' secular trend. Deviations of the actual items from the line of secular trend are thus conceived of as departures from normal, or 100 per cent. These percentage relatives of the individual items of the twelve crop series are given in Table VII.

The adjusted index of the physical volume of agricultural production finally is obtained by computing for each year a weighted arithmetic mean of the twelve percentage relatives of the year. The same weights are employed as in the calculation of the unadjusted index. The adjusted index, as thus derived, is given in Table VIII, and shown graphically in Chart V.



ERROR: The figure for 1899 should be 102.2 instead of 99.2 as plotted.

CHART V. — ADJUSTED INDEX OF PHYSICAL PRODUCTION FOR AGRICULTURE, 1879–1920.
(*Ordinates of secular trend = 100*)

TABLE VII. — PERCENTAGES OF ACTUAL PRODUCTION TO ORDINATES OF SECULAR TREND FOR TWELVE IMPORTANT CROPS 1879–1920

Year	Hay	Corn	Oats	Wheat	Barley	Rye	Rice	White potato	Sugar	Tobacco	Cotton	Flaxseed
1879	97.6	108.5	79.9	111.6	148.8	100.0	81.3	135.6	85.3	102.8	110.3	107.1
1880	85.2	116.9	87.9	121.0	141.2	102.1	103.5	119.6	104.1	96.9	122.0	128.0
1881	91.1	79.2	84.0	90.8	111.5	84.7	92.6	74.4	83.9	95.2	94.1	101.5
1882	96.1	104.3	94.6	116.6	117.0	120.6	88.0	111.6	106.8	102.7	119.4	96.8
1883	114.9	97.5	106.4	95.2	107.2	111.1	95.0	130.5	122.6	90.4	92.5	79.8
1884	115.7	110.0	104.7	113.3	118.4	111.6	91.9	114.9	98.9	109.6	88.2	99.4
1885	104.1	115.8	109.0	77.2	103.1	83.5	123.0	101.5	112.1	113.1	98.3	144.9
1886	94.8	97.2	104.4	96.8	96.6	92.6	124.6	94.0	95.4	102.4	93.7	106.0
1887	91.7	83.0	106.7	94.6	85.5	77.0	88.9	72.4	114.7	89.2	98.5	106.1
1888	100.8	110.7	109.9	84.5	89.5	104.2	95.5	105.6	94.6	102.8	95.5	86.6
1889	103.8	108.9	121.6	86.4	102.5	102.6	98.8	101.7	91.2	98.2	99.5	94.0
1890	101.1	77.8	84.3	73.8	89.9	94.1	100.5	73.7	99.8	100.0	110.4	74.0
1891	98.3	107.2	119.9	111.8	112.1	115.0	112.0	121.5	79.7	100.2	111.6	158.0
1892	97.0	87.5	96.6	99.2	101.0	101.3	167.5	75.7	96.6	97.6	80.5	88.2
1893	107.2	85.4	91.3	78.8	87.2	97.6	85.0	87.2	106.0	99.6	87.9	75.2
1894	95.4	65.7	94.1	93.5	77.3	99.8	74.5	79.9	101.6	97.6	114.1	53.8
1895	77.5	111.1	113.4	101.2	108.4	103.4	112.3	134.1	99.2	95.6	79.1	102.5
1896	98.6	118.0	97.4	95.0	89.7	94.8	63.3	111.9	106.5	96.6	91.7	113.1
1897	104.7	99.2	96.4	104.7	89.2	108.2	67.7	76.6	127.7	91.6	115.1	77.6
1898	116.4	102.6	100.1	130.2	82.5	105.1	65.5	85.6	96.3	102.5	116.7	96.9
1899	98.3	109.3	107.3	105.5	92.8	95.7	89.0	99.3	74.0	124.7	93.1	112.4
1900	89.4	109.6	102.5	98.4	73.6	95.9	89.2	92.3	95.9	114.8	98.3	94.2
1901	92.0	69.1	86.2	126.8	89.9	95.7	120.9	72.3	106.4	112.9	90.2	129.1
1902	105.7	110.7	114.2	114.5	106.4	107.1	89.2	104.5	105.5	110.8	98.4	142.3
1903	108.4	97.1	89.9	103.4	101.1	96.0	141.8	91.1	90.5	108.0	89.1	88.0
1904	108.2	102.9	104.4	91.3	107.9	94.4	135.4	119.8	99.0	85.5	118.8	80.6
1905	112.1	110.2	108.5	109.5	109.7	103.1	80.4	92.8	98.1	80.4	91.4	104.6
1906	100.3	114.4	102.9	112.5	120.1	105.9	97.8	108.1	96.6	84.7	112.3	100.4
1907	107.4	97.7	78.7	93.4	103.0	101.5	95.6	103.1	108.0	84.9	92.0	108.4
1908	114.7	97.4	81.0	93.1	108.8	101.3	104.5	94.5	100.8	85.6	107.4	115.5
1909	107.1	96.9	100.2	99.6	107.5	99.1	109.4	121.0	105.4	110.9	79.5	123.6
1910	98.3	107.1	109.2	89.0	96.7	96.6	103.8	105.0	99.4	126.1	90.5	64.9
1911	76.6	92.5	83.3	85.9	86.8	90.7	91.9	86.5	112.1	101.4	119.9	105.6
1912	99.9	112.5	125.8	99.6	117.5	96.5	95.2	121.8	93.5	105.8	102.7	163.5
1913	86.8	86.8	97.7	102.6	91.6	110.8	93.1	94.2	93.4	102.5	104.1	111.1
1914	93.5	93.5	97.7	118.3	97.7	113.3	81.6	114.4	93.6	108.9	116.5	91.4
1915	112.9	103.3	130.3	134.4	112.0	141.7	95.4	98.6	91.8	109.5	79.4	99.6
1916	118.1	87.3	103.6	82.3	87.1	126.7	129.0	77.4	97.3	116.4	79.7	108.4
1917	106.4	102.8	129.6	81.3	98.8	161.6	105.2	117.2	79.0	123.4	77.3	74.3
1918	96.5	82.8	123.0	116.1	117.0	231.2	112.4	107.3	81.3	139.5	81.0	115.6
1919	113.4	95.3	98.3	117.1	74.0	222.5	115.0	91.7	....	131.8	75.5	82.4
1920	108.1	100.9	111.7	94.6	85.2	194.0	140.7	104.2	....	144.4	83.2	116.5

Study of the adjusted index as given in table and chart discloses a number of highly significant facts. The strikingly low relative production of 1881, 1887, 1890, 1892–94, 1901, 1905, 1911, and 1913, is at once evident. The high production of 1880, 1884, 1891, 1898, 1902, 1906, and 1912 is just as clear. In general the years from 1916–19 do not quite maintain the customary annual increases of the pre-war period. The present crop year, 1920, however, promises to bring agricultural production back to the level indicated by pre-war tendencies. Whether this increase will be maintained in the years just ahead remains to be seen. Meanwhile it will be interesting, in the parts of the present study which will appear later, to turn to the analysis of the physical volume of production in other lines than agriculture.

Table VIII. — Adjusted Index of Physical Production for Agriculture, 1879–1920

(Ordinates of Secular Trend = 100)

Year	Index	Year	Index	Year	Index	Year	Index
1879	106.2	1890	89.0	1901	88.5	1911	94.0
1880	110.8	1891	108.4	1902	108.0	1912	108.3
1881	86.8	1892	90.5	1903	97.5	1913	94.2
1882	107.1	1893	90.0	1904	105.6	1914	102.6
1883	102.0	1894	87.9	1905	104.8	1915	106.3
1884	106.7	1895	99.1	1906	109.1	1916	92.3
1885	104.5	1896	103.4	1907	96.5	1917	98.6
1886	96.8	1897	102.7	1908	100.2	1918	96.1
1887	91.6	1898	109.0	1909	97.8	1919	98.2
1888	101.5	1899	102.2	1910	100.1	1920	100.3
1889	103.5	1900	100.3				